NATIONAL BUREAU OF STANDARDS REPORT

5767

Development, Testing, and Evaluation of Visual Landing Aids
Consolidated Progress Report for the Period October 1 to December 31, 1957

By
Photometry and Colorimetry Section
Optics and Metrology Division

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

THE NATIONAL BUREAU OF STANDARDS

Functions and Activities

The functions of the National Bureau of Standards are set forth in the Act of Congress, March 3, 1901, as amended by Congress in Public Law 619, 1950. These include the development and maintenance of the national standards of measurement and the provision of means and methods for making measurements consistent with these standards; the determination of physical constants and properties of materials; the development of methods and instruments for testing materials, devices, and structures; advisory services to Government Agencies on scientific and technical problems; invention and development of devices to serve special needs of the Government; and the development of standard practices, codes, and specifications. The work includes basic and applied research, development, engineering, instrumentation, testing, evaluation, calibration services, and various consultation and information services. A major portion of the Bureau's work is performed for other Government Agencies, particularly the Department of Defense and the Atomic Energy Commission. The scope of activities is suggested by the listing of divisions and sections on the inside of the back cover.

Reports and Publications

The results of the Bureau's work take the form of either actual equipment and devices or published papers and reports. Reports are issued to the sponsoring agency of a particular project or program. Published papers appear either in the Bureau's own series of publications or in the journals of professional and scientific societies. The Bureau itself publishes three monthly periodicals, available from the Government Printing Office: The Journal of Research, which presents complete papers reporting technical investigations; the Technical News Bulletin, which presents summary and preliminary reports on work in progress; and Basic Radio Propagation Predictions, which provides data for determining the best frequencies to use for radio communications throughout the world. There are also five series of nonperiodical publications: The Applied Mathematics Series, Circulars, Handbooks, Building Materials and Structures Reports, and Miscellaneous Publications.

Information on the Bureau's publications can be found in NBS Circular 460, Publications of the National Bureau of Standards ($1.25) and its Supplement ($0.75), available from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Inquiries regarding the Bureau's reports should be addressed to the Office of Technical Information, National Bureau of Standards, Washington 25, D. C.

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Development, Testing, and Evaluation of Visual Landing Aids

Consolidated Progress Report
to
Ship Installations Division
Bureau of Aeronautics
Department of the Navy
Washington 25, D. C.

For the Period
October 1 to December 31, 1957

For
Bureau of Aeronautics Projects
TED No. NBS-AE-10002
TED No. NBS-AE-10011

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

Development, Testing, and Evaluation of
Visual Landing Aids

October 1 to December 31, 1957

I. REPORTS ISSUED

Report No.	Title
5664	Development, Testing, and Evaluation of Visual Landing Aids, Consolidated Progress Report for the Period July 1 to September 30, 1957.
5644	The Determination of the Effective Intensity of Composite Light Units in Restricted Visibility.

II. RESEARCH AND DEVELOPMENT, LABORATORY TESTING, AND CONSULTATION SERVICES IN CONNECTION WITH VISIBILITY, AIRFIELD LIGHTING, AND FOG MODIFICATION PROBLEMS (TED NBS-AE-10002).

a. Visibility Meters and Their Application.

A group of type WL-759 trigger tubes from a recent production were received for testing. It was found that for about half the tubes the starter-anode voltage required to trigger the tube was too high to permit these tubes to operate in the transmissometer receiver circuit. The required starter-anode voltage of the remainder of the tubes rose to an unsatisfactory level after periods of operation varying from a few days to several weeks. The manufacturer was immediately advised and a conference called to discuss the steps to be taken to obtain satisfactory tubes.

If digital read-out systems operated from the transmissometer pulse signal are to be used, it is very desirable that the pulse rate of the receiver be increased. An increase in pulse rate could, of course, be obtained by increasing the intensity of the projector. This procedure is undesirable since it would require either shortening the life of the lamp, or using a projector of larger aperture than is available in a sealed-reflector type of lamp. Redesigning the receiver to use a lens of larger aperture is also considered undesirable. A small increase in pulse rate can be obtained by decreasing the capacitance of the charging capacitor (C101). Therefore, a study is being made of circuit modifications which will produce an increase in pulse rate. A method which preliminary tests indicate will be satisfactory is the connection

of a resistor and a capacitor in parallel between the cathode of the trigger tube (V102) and ground. Service tests will be made of receivers using this modification as soon as the instruments now being used in life testing trigger tubes are available.

b. Airfield Lighting and Marking.

Lightweight Optical Glide-Path System. Lamps and color filters for use in a feasibility model of the lightweight optical glide-path system described in the Progress Report for June - September 1957 have been obtained and shipped to the Naval Air Engineering Facility, Philadelphia.

Runway-Distance-Marker Paints. The exposure of test panels for the study of the effects of outdoor weathering of fluorescent paint was completed. These exposures were made at Naval Air Stations Atlantic City, New Jersey; Miramar, California; Quonset Point, Rhode Island; and Sanford, Florida. Reflectance data to indicate the results of the exposures have been taken. A report is being prepared and is expected to be completed before the end of the next quarter.

Runway-Marking Materials. Tests of physical properties, other than optical, of several runway-marker materials were completed during the quarter. These tests were: impact adhesion, plasticity, abrasion resistance, temperature cycling, and laboratory aging. A report of the results of these tests is in preparation and its completion is expected during the next quarter. Optical tests to observe the effects of these physical tests are expected to be completed during the next quarter.

c. Seadrome Lighting.

Cable-Fed Buoy-Mounted Sealane Lights. The preproduction sealane light designed for buoy-mounted cable-fed service has been received and photometric tests have been made. All parts of the light except the lens and filter are identical with those used in the type MB-1 light. The lens is a cylindrical Fresnel-type lens designed for use with a 500-watt, 20-ampere lamp with a C-8 filament. The filter is of one piece instead of two. When the lamp described above is used, the average intensity of the light at 5 degrees elevation is approximately 1000 candles (with the green filter in place) and the vertical beam spread at 500 candles is approximately 13 degrees. The manufacturer has been instructed to proceed with the production of the remainder of the order. Delivery

is expected in January.

The lamps manufactured for use in this light have been received and tested. The life and efficiency of these lamps is very satisfactory.

Redesign of the Electrical Circuit of the Type FMF-6B Sealane Light. A study of the redesign of the lamp circuit of the type FMF-6B buoy-mounted, 6-watt fluorescent sealane light has been started. Two possible lamp circuits are being considered: 1) the present circuit which draws 100 milliamperes from a 90-volt battery, 2) a circuit employing a vibrator-type power supply drawing 2 amperes from a 6-volt battery.

Several types of batteries are being investigated as possible sources of power:

1. The 90-volt ~~dog~~ dry battery employed in the present design,
2. A 6-volt, charge-retaining type, lead-acid battery,
3. 6-volt and 90-volt nickel-cadmium batteries,
4. 6-volt and 90-volt silver-zinc and silver-cadmium batteries.

The characteristics of both lamp circuits have been determined. The investigation to date shows an average value of 4.2 candles per watt from the 90-volt circuit and 2.2 candles per watt from the 6-volt circuit.

d. Carrier Lighting and Marking.

The joint Navy - Contractor meetings held at the plant of Control Instruments, Inc., Brooklyn, N.Y. on November 6 and at Burroughs Research Center, Paoli, Pa. on November 14 were attended and the results of National Bureau of Standards studies in this field were presented and their bearing on the designs of the optical glide-path systems being designed by the contractors discussed.

e. Lights for Carrier-Deck Personnel.

Initial production equipment of the LSO lighted suit has been received and found satisfactory, in conformity with the requirements of the specification.

The flashlight-mounted illuminated wands used by plane directors to guide aircraft around the deck have been redesigned to increase efficiency and reduce size and weight. Models of the new wands have been constructed. The new wand utilizes two size C cells instead of size D. The plastic part of the wand is a solid methacrylate cone with a diffusing finish. It provides much better uniformity of brightness, much higher efficiency, and the complete assembly is smaller and lighter. It is recommended that immediate steps be taken to replace the present wands with the improved model.

A version of the "eyeball" lights demonstrated during the August 1957 carrier trip has been built by attaching two small fixtures to the standard goggles used by deck personnel. The original version was mounted on a separate headband. Additional versions, for attachment to helmets, will be constructed, and various methods of providing power for them will be tested. The use of rechargeable nickel-cadmium batteries in all of this equipment is being studied and appears promising.

III. VISIBILITY AND BRIGHTNESS TESTS, SURVEYS, EVALUATION AND ANALYSIS OF VISUAL LANDING AIDS, BASIC TESTS AND EQUIPMENT, AS A FIELD SERVICE AT ARCATA, CALIFORNIA (TED NBS-AE-10011).

a. Airfield Lighting and Marking.

Turn-off Lights. Runway lights were installed at another taxiway turn-off. They were installed paralleling the taxiway and in line with the taxiway lights. Pilot comment indicates a preference for the turn-off lights installed in this manner rather than having these indicator lights paralleling the runway lights. In all cases the pilots are more concerned with color than placement of the lights. This is evidenced by the fact that their attention has to be called to the installation before they are aware of the lights or their use.

Approach Beacons. A request has been received from a Southwest Airways pilot to install the approach beacons on the approach to runway 13. At this time C.A.A. is unwilling to allow an installation although the new low antennas for the localizer are some 200 feet from the bluff and our installation would have to be only slightly above ground elevation.

b. Electrical Engineering.

Survey Trip. The draft of the report on the Survey of West Coast Air Stations has been revised and additional information included. The final draft will be completed and the report issued during the next quarter.

Maintenance Manual. The troubleshooting charts of NBS Report 5243, Maintenance of Airfield Lighting Systems, Part III, Troubleshooting of Series Circuits, have been redone in larger type to improve their legibility. An order has been placed with the Commerce Department for the additional copies of the report requested by the Bureau of Aeronautics.

Cable Tracing. Further checks have been made of the performance of the TSM-11 Cable-Test Detecting Sets in dry soil conditions. The results obtained were much poorer than expected. An analysis of the conditions of test indicates that when the soil conductivity is low, a return flow of current through pipes, metallic ducts, and grounded cables other than the cable under test can give misleading results particularly if that cable has several grounds. Also false signals can be induced in cables which lie in the same duct or trench as the one under test, especially if the cables are twisted together as they are laid. Under these conditions, sectionalizing the circuit under test appears to be necessary. Further tests will be conducted after the soil on the airfield has been thoroughly soaked during the rainy season.

Over-current Protective Device for Monocyclic-Square Constant-Current Regulators. The presence of isolating transformers with open-circuited secondaries in series lighting circuits supplied through monocyclic-square type constant-current regulators tends to produce an increase in the output current of the regulator. If the regulator does not have sufficient compensation, this increase in current can seriously shorten lamp life and in some cases has caused a progressive burning out of lamps until all lamps in the circuit have failed. The compensation required by paragraph 3.8.2 of Specification MIL R7728 is not sufficient to prevent a very large decrease in lamp life. To overcome this difficulty, an over-current control is being designed to decrease automatically the brightness setting of the regulator from step 5 to step 4 whenever the step 5 lamp current increases to a value which will seriously shorten lamp life. A feasibility model

has been sent from Washington to Arcata for field tests. The results there showed that the unit is unsatisfactory in its present form. Tests indicate that the unit responds to the average, not the rms, current and that as the number of isolating transformers which are open circuited increases, the rms current increases but the average current decreases slightly. In addition, time delays are required so that the control will not respond to momentary increases in current caused by line voltage surges and the high inrush current when the circuit is energized. The unit is being redesigned to overcome these difficulties.

c. Research on Visibility and Visibility Measurements.

Effective Intensity of Composite Light Sources. NBS report 5644, The Determination of the Effective Intensity of Composite Light Units in Restricted Visibility, has been issued. In this study, 6- and 10-lamp units 14 feet long were used. The results of the work indicate the following.

As was expected, the effective intensity of a composite light source increased as the visual range of the unit increased, and this increase was more rapid for nighttime than for daytime.

When the visual range of the composite unit was within the region of the visual ranges representative of service conditions, the ratio of the effective intensities of the 10-lamp unit to the 6-lamp unit was approximately equal to the ratio of the number of lamps in the units. For lamp spacings that are typical of those used in service, the effective intensity of a composite unit may be considered proportional to the number of lamps in the unit.

For daylight conditions the "shape" factor developed by de Boer provides a satisfactory means of determining the equivalent point-source intensity of composite light units.

Effective Intensity of Flashing Light Sources. The draft of the field testing section of the flashing light sources report has been completed. Four lights of flash durations of approximately 30 microseconds, 200 microseconds, 0.5 second, and 0.3 second were used in the tests. These lights have been shipped to Washington for photometric measurements. This report should be issued during the next quarter.

Transmissometers. A larger baffle was constructed for the photocell of the transmissometer calibrator employing a field stop. This baffle was considerably more easy to align. Tests of the effectiveness of the baffle in eliminating stray light indicate that the baffle is not necessary under normal operating conditions. The small amount of stray light encountered is eliminated by the zero checks of the calibrator. An alignment telescope designed for use with the manufactured units was constructed and sent to Washington for evaluation. Work on the calibrator report has been started. The first draft should be completed shortly.

Comparison tests of the stability of indicators with standard and modified bridges have continued.

The obtaining of data of the effect of scattered light on transmission measurements has continued during periods of low visibility. The red-sensitive phototube is now being replaced by a blue-sensitive phototube. The results to date indicate that the error introduced by scattered light does not produce a significant error in the indicated visibility.

U. S. DEPARTMENT OF COMMERCE

Sinclair Weeks, *Secretary*

NATIONAL BUREAU OF STANDARDS

A. V. Astin, *Director*

THE NATIONAL BUREAU OF STANDARDS

The scope of activities of the National Bureau of Standards at its headquarters in Washington, D. C., and its major field laboratories in Boulder, Colorado, is suggested in the following listing of the divisions and sections engaged in technical work. In general, each section carries out specialized research, development, and engineering in the field indicated by its title. A brief description of the activities, and of the resultant reports and publications, appears on the inside front cover of this report.

WASHINGTON, D. C.

Electricity and Electronics. Resistance and Reactance. Electron Tubes. Electrical Instruments. Magnetic Measurements. Dielectrics. Engineering Electronics. Electronic Instrumentation. Electrochemistry.

Optics and Metrology. Photometry and Colorimetry. Optical Instruments. Photographic Technology. Length. Engineering Metrology.

Heat and Power. Temperature Physics. Thermodynamics. Cryogenic Physics. Rheology and Lubrication. Engine Fuels.

Atomic and Radiation Physics. Spectroscopy. Radiometry. Mass Spectrometry. Solid State Physics. Electron Physics. Atomic Physics. Nuclear Physics. Radioactivity. X-rays. Betatron. Nucleonic Instrumentation. Radiological Equipment. AEC Radiation Instruments.

Chemistry. Organic Coatings. Surface Chemistry. Organic Chemistry. Analytical Chemistry. Inorganic Chemistry. Electrodeposition. Gas Chemistry. Physical Chemistry. Thermochemistry. Spectrochemistry. Pure Substances.

Mechanics. Sound. Mechanical Instruments. Fluid Mechanics. Engineering Mechanics. Mass and Scale. Capacity, Density, and Fluid Meters. Combustion Controls.

Organic and Fibrous Materials. Rubber. Textiles. Paper. Leather. Testing and Specifications. Polymer Structure. Organic Plastics. Dental Research.

Metallurgy. Thermal Metallurgy. Chemical Metallurgy. Mechanical Metallurgy. Corrosion. Metal Physics.

Mineral Products. Engineering Ceramics. Glass. Refractories. Enameled Metals. Concreting Materials. Constitution and Microstructure.

Building Technology. Structural Engineering. Fire Protection. Heating and Air Conditioning. Floor, Roof, and Wall Coverings. Codes and Specifications.

Applied Mathematics. Numerical Analysis. Computation. Statistical Engineering. Mathematical Physics.

Data Processing Systems. SEAC Engineering Group. Components and Techniques. Digital Circuitry. Digital Systems. Analogue Systems. Application Engineering.

- Office of Basic Instrumentation
- Office of Weights and Measures

BOULDER, COLORADO

Cryogenic Engineering. Cryogenic Equipment. Cryogenic Processes. Properties of Materials. Gas Liquefaction.

Radio Propagation Physics. Upper Atmosphere Research. Ionospheric Research. Regular Propagation Services. Sun-Earth Relationships.

Radio Propagation Engineering. Data Reduction Instrumentation. Modulation Systems. Navigation Systems. Radio Noise. Tropospheric Measurements. Tropospheric Analysis. Radio Systems Application Engineering.

Radio Standards. Radio Frequencies. Microwave Frequencies. High Frequency Electrical Standards. Radio Broadcast Service. High Frequency Impedance Standards. Calibration Center. Microwave Physics. Microwave Circuit Standards.


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